WEINSCHEL
H2640

B-2

MP MASTER
MA35936

INSTRUMENT SHOP

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OPERATION AND SERVICE MANUAL FOR MODEL H2640 RF OSCILLATOR UNIT

For information on Sweep Oscillator Mainframe, see Operation and Service Manual IM90 (MP).

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MANUAL CHANGE INFORMATION

OSCILLATOR MANUAL

Change	Unit	Page	Nature of Change
387	ALL		R874 changes from 220 ohm (301-221) to 215 ohm (305-063) R900 changes from 100 ohm (301-101) to 147 ohm (305-046) Z829, Z845 and Z846 change from 1N753A (6V)(501-007) to 1N759A (12V)(501-008)
403	All Grid Leveled Units		Add Z850 (500-005) SCE2
412	All VTM Units		Add R994, R995 and R996 470K ohm/2W (303-473)

CAUTION

The power level at the RF output terminal may exceed the power rating of standard detectors. This power level can cause burnout of crystal diodes and power meter elements. The operator should, therefore, insert an appropriate amount of attenuation when this instrument is used with crystal detectors, thermistor mounts, bolometers, etc. . .

TABLE OF CONTENTS

MICROWAVE SWEEP OSCILLATOR

OSCILLATOR UNIT

		Page
I.	General Description A. Plug-in Oscillator Unit replacement	3
II.	Specifications	4
III.	Principles of Operation (Refer to Section III Page S5 in the Basic Unit Instruction Manual)	
IV.	Controls	6
V.	Inputs	7
VI.	Protective Circuits (Refer to Section VI Page S19 in the Basic Unit Instruction Manual)	
VII.	Calibration	8
VIII.	Tube Replacement	19
IX.	Parts list	20
X.	Warranty	27
XI.	Component location	31
XII.	Schematic	32

LIST OF TABLES

Table		Page
1	Model 221 Plug-Ins and Accessories	5A

I. GENERAL DESCRIPTION

This plug-in Oscillator Unit is to be used in conjunction with a Model 221 Basic Unit manufactured by Micro-Power, Inc. When this Oscillator is inserted into the Model 221 Basic Unit the equipment will meet the specifications listed in Section II of this manual. See Table 1 Page 5A for list of Plug-in Oscillators.

A. CHANGING THE FREQUENCY RANGE OF THE MICROWAVE SWEEP OSCILLATOR

The following steps must be taken to change the frequency band of operation of the Model 221 Microwave sweep oscillator. (Example: There is currently installed in the Basic Unit a 1-2 GHz Oscillator, and it is desirable to change to a 2-4 GHz Oscillator.)

1. Turn the POWER switch to the OFF position.

2. Remove the four (4) knurled nuts holding the 1-2 GHz scale to the Basic Unit front panel and remove the 1-2 GHz dial scale.

3. Remove the two (2) screws holding the 2-4 GHz dial scale to the side of the 2-4 GHz plug-in Oscillator Unit and remove the 2-4 GHz dial scale.

4. Place the 2-4 GHz dial scale on the Basic Unit front panel and fasten it with the four (4) knurled nuts.

5. Turn the thumb screw located on the front panel of the 1-2 GHz Oscillator unit 2-3 full turns counter clockwise, and by pulling forward on the thumb screw remove the Oscillator Unit from the 221 Basic Unit.

6. Turn the front panel thumb screw on the 2-4 GHz Oscillator Unit one (1) turn counterclockwise and insert the 2-4 GHz plug-in Oscillator Unit into the 221 Basic Unit and turn the thumb screw clockwise until tight.

7. Place the 1-2 GHz dial scale on the scale mounting studs of the 1-2 GHz Oscillator Unit and fasten it with two 6-32 3/8" long screws. CAUTION must be taken in the storage of spare Oscillator Units in that a four inch (4") distance away from ferrous materials must be maintained. A suggested storage receptacle is the Micro-Power Model 200 Storage Unit.

8. Turn POWER switch to RF ON position after a one (1) minute time delay; the equipment will be ready for operation in the 2-4 GHz frequency range.

II. SPECIFICATIONS

RF FREQUENCY RANGE: the frequency range is determined by the plug-in oscillator used. Refer to Table 1, page 5A.

RF OUTPUT POWER: the power output is determined by the plug-in oscillator used. Refer to Table 1, page 5A.

SWEEP PRESENTATION:

- END LIMIT: between any 2 frequencies in band.
- MARKER END LIMIT: between any 2 frequencies in band.
- SYMMETRICAL: calibrated and adjustable from 0-100% of the frequency band covered.
- EXTERNAL: direct coupled 20 volts for full sweep, positive voltage increases RF frequency. Response time: 200 microseconds for full sweep with increasing frequency and 2 milliseconds for full sweep with decreasing frequency. Provision for external resistance programming.
- CW OPERATION: 4 independent single frequencies calibrated and continuously variable.

MARKER: 2 independent adjustable markers displayed either as dips in RF output or externally as $\pm$ video markers.

- ACCURACY: BWO units $\pm$ 1%, VTM units $\pm$ 1.5%
- RESOLUTION: less than 0.05% of sweep range
- AMPLITUDE: continuously variable
- OUTPUT: auxiliary video marker, amplitude 5 volts.

SWEEP RATE: decade from 0.01 sweep/sec to 100 sweep/sec, vernier 10 to 1 continuously adjustable.

TRIGGERED SWEEP:

- INTERNAL: recurrent.
- LINE: line frequency.
- EXTERNAL: 10 volts negative input will initiate sweep.
- MANUAL: front panel pushbutton.

SWEEP OUTPUT: direct coupled, adjustable from 0-15 volts peak.

PROPORTIONAL OUTPUT: direct coupled voltage proportional to instantaneous frequency; 0 volts at low end and 10 volts at high end.

BLANKING OUTPUT: 10 volts negative

PEN LIFT OUTPUT: relay contact closure during forward trace portion of sweep.

BASE LINE: switch selects RF ON or OFF during retrace.

FREQUENCY STABILITY:

- RESIDUAL FM: BWO units; 2 ppm peak (See section IV, par. 3, Page 515 of the 221 Basic Unit Instruction Manual covering controls and sweep speed selector.)
  VTM units; 10 ppm typical.
- LINE REGULATION: $\pm$ 5 ppm maximum for $\pm$ 10% change in line voltage.

LEVELED RF OUTPUT: Internal feedback amplifier maintains output power variation to within 0.1 dB plus coupler and detector variation. When operated with internal directional detector, total power variation is as indicated on page 1 of this manual. Optional use with external directional coupler and RF crystal detector or RF power meter.

MODULATION:

INTERNAL AM: square wave modulation adjustable from 950 to 1050 Hz.

EXTERNAL AM: 20 volts positive signal increases RF output to maximum, rise and fall times for BWO units are 0.1 microseconds unleveled and approximately 10 microseconds leveled; for VTM units rise and fall times are 1.0 microseconds unleveled and approximately 10 microseconds leveled.

EXTERNAL FM: BWO units; direct coupled input provides frequency response in excess of 5 MHz.

RESIDUAL AM: 40 dB below rated RF output.

SPURIOUS SIGNALS: Non-Harmonics 40 dB below rated RF output, harmonics 20 dB below rated RF output.

GENERAL:

DIMENSIONS: 8 3/4" high x 17 1/4" wide x 17 1/2" deep, rack mounting adaptors included.

AMBIENT OPERATING TEMPERATURE: -10° to +50°C.

POWER SWITCH: OFF, RF OFF, RF ON.

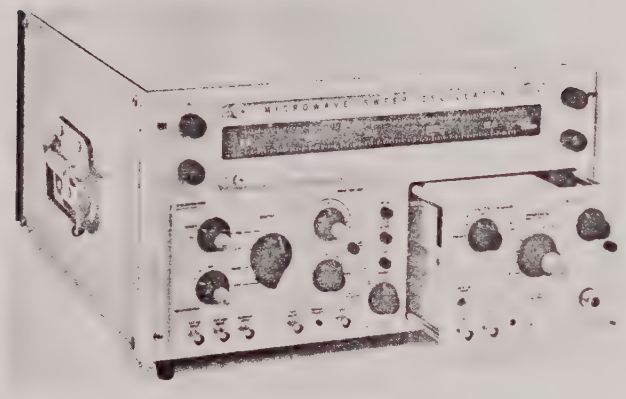
POWER INPUT: 105 to 125 VAC 50-65Hz, approximately 150 VA. 210 to 250 VAC optional, 400 Hz operation on special order.

WEIGHT: 12 to 25 lbs. depending upon unit

TABLE I

MICROWAVE SWEEP OSCILLATOR

MODEL 221



Oscillator Mainframe With Plug-in

Accessories:

Model 200 Storage Enclosure
" 201 Remote Freq. Control
" 202 Multi-Band Sweep Control
" 203A Calibration Unit

Model 221 System 1 - 1-12.4 GHz Sweep System

PLUG-IN OSCILLATORS

	GRID LEVELED				DIODE LEVELED			
		Internal directional detector				Internal directional detec		
		Without	With			Without	With	
Frequency Range (Gc)	Min. Power* Output (mW)	Model	Model	Leveled Power Variation (dB)	Min. Power* Output (mW)	Model	Model	Leveled Power Variati (dB)
0.2-0.4	-	-	-	-	20	H24MD	-	-
0.25-0.5	-	-	-	-	50	H25MD	-	-
0.35-0.7	-	-	-	-	100	H37MD	-	-
0.4-1.2	-	-	-	-	20	H41MD	-	-
0.5-1.0	-	-	-	-	100	H51MD	-	-
0.5-1.0	30	H51B	-	-	15	H51DB	-	-
1-2**	-	-	-	-	40	H102SD	H102SDL	±0.3
1-2	100	H102	H102L	±0.3	60	H102D	H102DL	±0.3
1.4-2.5	100	H142	H142L	±0.3	60	H142D	H142DL	±0.3
1.7-4.2	-	-	-	-	15	H204DA	H204DLA	±0.5
2-4**	-	-	-	-	20	H204SD	H204SDL	±0.5
2-4	80	H204	H204L	±0.5	40	H204D	H204DL	±0.5
3.5-6.75	40	H356	H356L	±0.5	25	H356D	H356DL	±0.5
3.7-8.3	-	-	-	-	8	H408DA	H408DLA	±0.5
4-8	30	H408	H408L	±0.5	20	H408D	H408DL	±0.5
7-11	25	H711	H711L	±0.5	10	H711D	H711DL	±0.5
7-12.4	25	H712	H712L	±1.0	10	H712D	H712DL	±1.0
8-12.4	50	H812	H812L	±0.75	25	H812D	H812DL	±0.75
10-15.5	20	H1015	-	-	-	-	-	-
12.4-18	40	H1218	-	-	-	-	-	-
18-26.5	20	H1826	-	-	-	-	-	-
26.5-40	5	H2640	-	-	-	-	-	-

** All-Solid State

*Value indicated for units without internal directional detector, 1 dB less with interna

IV. CONTROLS

1. SYMMETRICAL SWEEP WIDTH
In each switch position, the sweep width is indicated by the panel calibration. When this switch is in the extreme clockwise position the potentiometer concentric with it is energized and can be used to vary the sweep width continuously from 0 to 100%.

2. RF LEVELER
In the XTAL INT position, the amplitude of the RF output is maintained constant independent of the RF frequency by means of the internal feedback leveling system. This description does not apply to Oscillator Units which have no internal leveling components. In these units the RF LEVELER switch is prevented from rotating to the XTAL INT position.
In the XTAL EXT position the feedback leveling amplifier operates with an external directional coupler and detector. The detected output is connected to the EXT DETECTOR INPUT on the front panel of the Oscillator Unit and should be of negative polarity.
In the OFF position the RF output is unleveled.
In the PWR MTR position leveling is achieved in the same manner as in the XTAL EXT position except that a power meter is used instead of the crystal detector. The recorder output of the power meter is connected to the EXT DETECTOR INPUT on the front panel of the Oscillator Unit. When using a power meter, the operator should restrict the sweep speed to the slower ranges because of the slower response time of the power meter element.

3. RF LEVEL
This control varies the RF output amplitude. With the RF LEVELER switch in the OFF position, the RF amplitude can be varied from 0 to maximum but it will be unleveled across the band. With the RF LEVELER IN XTAL INT, XTAL EXT, (with an external directional coupler) or PWR MTR (with a power meter) positions, the RF LEVEL control sets the maximum level of the RF amplitude across the band. In those portions of the band where there is sufficient RF power to reach this level the output will be leveled. In those portions of the band where there is insufficient RF power, the output will be unleveled, and the unleveled indicator will be lighted.
The operator can therefore set the RF LEVEL control so that a leveled output is obtained across the entire frequency range of the unit, or he can set this control to obtain a higher leveled output over a portion of the range where higher RF power is available.

V. INPUTS

1. EXTERNAL DETECTOR INPUT

Provision is made for the use of an external directional coupler-detector having an output of negative polarity together with the internal feedback leveling amplifier in the Oscillator Unit. In its use, however, attention must be paid to meeting the stability requirements of the feedback loop. This is done by connecting the output of the detector to the EXT DETECTOR INPUT and adjusting the GAIN control. This GAIN control is located on the oscillator unit panel and is a screw driver adjustment. With the unit on, the RF LEVELER in the EXT position and the RF LEVEL control in its maximum clockwise position, the gain control should be adjusted so that the RF amplitude is leveled just at its maximum value.

2. FM INPUT *

This input can be used to direct couple wide band signals to the helix of the BWO to obtain rapid frequency modulation of the RF output. The capacity at this input is a few hundred picofarads. Using a video generator with a 50 ohm source impedance the band-width is approximately 5 MHz. The maximum signal levels that should be applied at this input is ± 20 volts. The modulation sensitivity (MHz/volt) will be different for each frequency range and will depend on the particular portion of the band; this sensitivity is approximately 0.1% per volt.

3. AM PULSE INPUT

This input can be used to couple pulses into the unit to obtain RF pulses at the output with rapid rise and fall times. The input signal is AC coupled to the grid of the BWO tube. In operation, the RF LEVELER switch should be in the OFF position; and the RF LEVEL control should be adjusted so that no power is obtained at the output with no pulse input. The input pulse amplitude should then be increased (approximately ±20 volts peak) until maximum power is obtained at the peak of the pulse.

* Not applicable to plug-in Oscillator Units using a Voltage Tunable Magnetron (VTM)

VII. CALIBRATION OSCILLATOR UNIT

A calibrated Basic Unit is required for the calibration of the Oscillator Unit.

With the plug-in oscillator unit inserted into the Basic Unit, turn the POWER control switch to RF OFF and allow a 15-minute warm-up period before proceeding with the calibration.

Test instruments required for calibration:

- direct coupled oscilloscope
- DC Voltmeter with at least 1/4% accuracy and capable of floating at 3 Kilovolts with respect to ground
- Frequency meter
- Microwave power meter
- DC milliammeter capable of floating at 3 Kilovolts with respect to ground.

For calibration the controls are set as follows:

**POWER	RF OFF	
AMPLITUDE	OFF	
1000Hz	MAX CW	
SWEEPS/SEC	10	
VARIABLE	MAX CW	
**SWEEP MODE	f1	
**MARKER AMPLITUDE	MAX CCW	
TRIGGER	INT	
M1	FL	FL: First Scale
M2	LL	Calibration Line
**f1	FL	(low frequency)
f2	MAX CW	
SYMMETRICAL SWEEP WIDTH	MAX CW	LL: Last Scale
SYMMETRICAL SWEEP VERNIER	MAX CW	Calibration Line
**RF LEVELER	OFF	(high frequency)
**RF LEVEL	MAX CW	
*HORIZONTAL SWEEP AMPLITUDE	MAX CW	
*RF DURING RETRACE	OFF	
*INTERNAL MARKER	ON	

* These controls are located on rear panel of basic unit.

** Specific changes in these settings will be called for whenever required. For convenience these control settings are also tabulated in Fig. 1, page 14.

HV CLAMP ADJUST	SET MAX CW
LV CLAMP ADJUST	SET MAX CCW

NOTE: The HV CLAMP ADJUST and LV CLAMP ADJUST are located inside the Plug-in Oscillator Unit. See Fig. 3, page 16 (BWO), Fig. 4, page 17 (VTM) for their location. They are accessible when the bottom covers of the Basic Unit and the Oscillator Unit are removed.

ADJUSTMENT STEPS

NOTE: Prior to servicing, the top and bottom covers of both the BASIC UNIT and the OSCILLATOR UNIT must be removed. Calibration is best accomplished while the BASIC UNIT rests on its left side.

1. DC FILAMENT ADJUST
Turn POWER switch to OFF position.

CAUTION: THE VOLTMETER AND THE ADJUSTMENT ARE AT KILOVOLT POTENTIAL WHEN THE POWER SWITCH IS IN THE RF ON POSITION.

Connect the voltmeter between terminals A and E on the printed circuit board (see fig. 3, page 15) with the positive terminal of the voltmeter connected to terminal A. With the POWER switch in the RF OFF position, adjust R216 DC FILAMENT ADJUST (see fig. 22, p. S32 b, Model 221 Basic Unit Manual) for a voltmeter reading of 6.3 volts for the BWO units and 5.6 volts for the VTM units.
Turn POWER switch to OFF position and disconnect the voltmeter.
For BWO units, proceed to step 2.
For VTM units, The OSCILLATOR UNIT is removed and connected to the BASIC UNIT by means of an extender cable. Also, using clip leads, ground the BASIC UNIT chassis to the OSCILLATOR UNIT chassis. Connect the voltmeter across R998 (1.0 ohm for VTM requiring up to 2.5A of filament current or 0.5 ohm for VTM requiring over 2.5A of filament current) at points P and Q (see fig. 5, page 18,) the positive lead of the voltmeter connected to point Q. Adjust R999 FILAMENT CURRENT ADJUST for a voltmeter reading V_r equal to

$V_r = 1.0 \times I_f$ for units requiring up to 2.5A, or
$V_r = 0.5 \times I_f$ for units requiring over 2.5A

where I_f is the value of the filament current specified for this particular tube and which appears on page 1 of this manual.
Proceed to step 3b.

2. HELIX CURRENT MAX ADJUST (BWO units only).
Connect a 20K ohm/volt Voltmeter across capacitor C819 (see p. 33 Component Location for the location of this capacitor).
Disconnect the BWO helix lead from terminal F and insert an ammeter between the helix lead and terminal F.
The voltage V_h and the helix current I_h have the following relation:

$$V_h = \frac{(6.2)\ (I_h)}{I_{max}}$$

Where I_h = measured helix current

V_h = measured voltage across C819

I_{max} = max helix current specified by manufacturer and indicated on page 1 of the OSCILLATOR Manual for the BWO type used.

With the POWER switch in the RF ON position, adjust R974 HELIX CURRENT MAX ADJ until the above relation is satisfied.
Example: If I_h = 1.5mA
I_{max} = 3.0mA

Adjust R974 for V_h = 3.1V
Proceed to step 3a.

3a. Preliminary ANODE VOLTAGE ADJUST - CATHODE CURRENT ADJUST (BWO units only)
Turn the unit off by rotating the Power switch to OFF position. Disconnect the CATHODE (yellow) lead of the BWO from terminal C. Connect a milliammeter between the CATHODE (yellow) lead of the BWO and terminal C, with the negative terminal of the meter connected to terminal C. Set the ammeter range to approximately 15 mA full scale. Turn R819 ANODE VOLTAGE ADJUST completely counterclockwise.

CAUTION: FOR THIS ADJUSTMENT SPECIAL CARE MUST BE EXCERCISED AS BOTH VOLTMETER AND ADJUSTMENT ARE AT KILOVOLT POTENTIALS.

Turn POWER switch to RF ON position. After the one minute time delay, and using AN INSULATED SCREWDRIVE adjust R819 ANODE VOLTAGE ADJUST so that the cathode current is the value indicated on page 1 for specific BWO installed.
Turn the unit off by rotating the POWER switch to OFF position and disconnect the ammeter. Reconnect the CATHODE (yellow) lead of the BWO terminal C and proceed to step 4.

3b. INJECTION ELECTRODE ADJUST- (VTM UNITS ONLY)
Turn the unit off by rotating the POWER switch to the OFF position. Connect the voltmeter between the cathode of the VTM (terminal 3) and the injection electrode of the VTM (terminal 1), with the negative lead of the voltmeter connected to the cathode (see fig. 5, page 18)

CAUTION: FOR THIS ADJUSTMENT SPECIAL CARE MUST BE EXERCISED AS BOTH VOLTMETER AND ADJUSTMENT ARE AT KILOVOLT POTENTIAL.

Turn POWER switch to the RF ON position. After the one minute time delay and using AN INSULATED SCREWDRIVER adjust R819 INJECTION ELECTRODE ADJUST (see fig. 4, page 17) to the voltage value specified by the tube manufacturer and which appears on page 1 of this manual. Turn the unit off by rotating the POWER switch to the OFF position. Disconnect the voltmeter and extender cable and reinsert the OSCILLATO UNIT into the BASIC UNIT.

4. LEVEL BALANCE

Note: This adjustment is to be made with an external directional coupler and detector.

Connect SWEEP OUTPUT to the horizontal amplifier input of osscilloscope and connect the detected RF OUTPUT to the vertical amplifier. Set RF LEVEL to max CCW. Set SWEEP MODE in f1-f2 position. Set f1 to max CCW position. Set RF LEVELER switch to XTAL EXT. Turn POWER switch to RF ON position. Adjust R936 LEVEL BALANCE until no RF output is visible.

CAUTION: WITH THE POWER SWITCH IN THE "RF ON" POSITION, KILOVOLT POTENTIALS ARE APPLIED TO THE MICROWAVE TUBE. ALTHOUGH THE FOLLOWING ADJUSTMENTS THEMSELVES ARE NOT AT HIGH POTENTIAL, CARE MUST BE EXERCISED TO AVOID ACCIDENTAL CONTACT WITH POINTS OF HIGH POTENTIAL INSIDE THE UNIT.

5a. LEVEL SET

Note: This adjustment is to be deleted for Oscillator Units which do not have internal leveling components.

Turn AMPLITUDE MOD to OFF, and turn RF LEVEL to MAX CW position, RF LEVELER to XTAL INT position. Adjust R937 LEVEL SET, so that the RF amplitude is leveled just at its maximum value.

5b. RF LEVEL MIN.

Note: This adjustment applies only to grid leveled units with internal leveling components.

Adjust the RF LEVEL control so that the display is just leveled across the full band. Insert a 6dB pad between the RF output and the indicating device and note the RF output level displayed. Remove the 6dB pad and turn the RF LEVEL knob to MAX CCW position. Adjust R966 RF LEVEL MIN so that the RF output level displayed is equal to the level observed with the 6dB pad inserted. Proceed to step 6.

6. Preliminary LOW FREQUENCY ADJUST

NOTE: For units that do not have internal leveling components, turn RF LEVELER switch to OFF position. For units having internal leveling components leave the RF LEVELER switch set at XTAL INT position.

Set RF LEVEL CONTROL so that the output is just leveled across the full sweep range for leveled units, or at MAX CW position for unleveled units. Set MARKER AMPLITUDE to approximately mid range. Connect Frequency Meter as in fig. 2B, page 15. Set M1 to first calibrated line appearing on the left hand side of the scale. Set the Frequency Meter to the frequency indicated by marker M1. Adjust R848 LOW FREQUENCY ADJUST so that the two indications coincide.

7. Preliminary HIGH FREQUENCY 1 ADJUST
Set M2 to last calibrated line appearing on the right hand side of the scale. Set the Frequency Meter to the frequency indicated by marker M2. Adjust R849 HIGH FREQUENCY 1 ADJUST so that the two indications coincide. For BWO units proceed to step 8; <u>for VTM units</u> proceed to step 9.

8. Final ANODE VOLTAGE ADJUST - CATHODE CURRENT ADJUST
(BWO units only) Repeat step 3a. Set controls as indicated in calibration chart page 14.

9. Final LOW FREQUENCY ADJUST
Repeat step 6. Set control as indicated on calibration chart page 14.

10. Final HIGH FREQUENCY 1 ADJUST

Repeat Step 7.

11. HIGH FREQUENCY 2 ADJUST
Set SWEEP MODE switch to SYM M1 (or SYM f1)*. Set f2 (or M2) at the last calibrated line (right hand side). Set frequency meter to the frequency indicated by that last calibration line. Turn M1 (or F1) to the same last calibration line. Adjust R850 HIGH FREQUENCY 2 ADJUST so that the two indications coincide.

12. HV CLAMP ADJUST
Set SWEEP MODE switch to f1-f2. Set M1 at the first calibrated line at the low frequency end of the scale and set M2 at the last calibrated line at the high frequency end of the scale. Set f1 MAX CCW and set f2 MAX CW. Adjust R916 HV CLAMP ADJUST so that the range of Frequency Sweep just reaches the high frequency marker M2.

13. LV CLAMP ADJUST
With all the controls set as in step 12, adjust R844 LV CLAMP ADJUST so that the range of frequency sweep just reaches the low frequency marker M1.

* Used on Basic Units that have this designation.

CALIBRATION STEPS		CONTROL SETTINGS														
		1	2	3a	3b	4	5a	5b	6	7	8	9	10	11	12	13
MARKER AMPLITUDE	MID-RANGE								X	X		X	X	X	X	X
	MAX CCW	X	X	X	X	X	X	X			X					
f1	MAX CW	FL	FL	FL	FL						FL					
	MAX CCW					X	X	X	X	X		X	X	X	X	X
RF LEVELER	XTAL INT						X	X	X	X		X	X	X	X	X
	XTAL EXT					X										
	OFF	X	X	X	X				0	0	X	0	0	0	0	0
RF LEVEL	MAX CW	X	X	X	X		X	&	&	&	X	&	&	&	&	&
	MAX CCW					X										
SWEEP MODE	f1-f2					X	X	X	X	X		X	X		X	X
	f1	X	X	X	X						X					
	SYM MI (SYM f1)													X		
POWER	RF OFF	X														
	RF ON		X	X	X	X	X	X	X	X	X	X	X	X	X	X

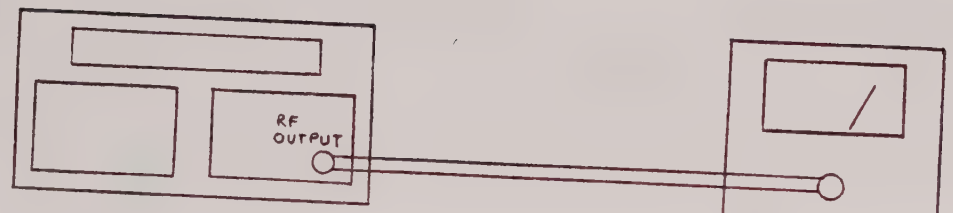
LEGEND: FL FIRST SCALE CALIBRATION LINE (LOW FREQUENY)

& AS SPECIFIED IN TEXT

0 FOR UNITS WITHOUT INTERNAL LEVELING COMPONENTS.

CALIBRATION — OSCILLATOR UNIT

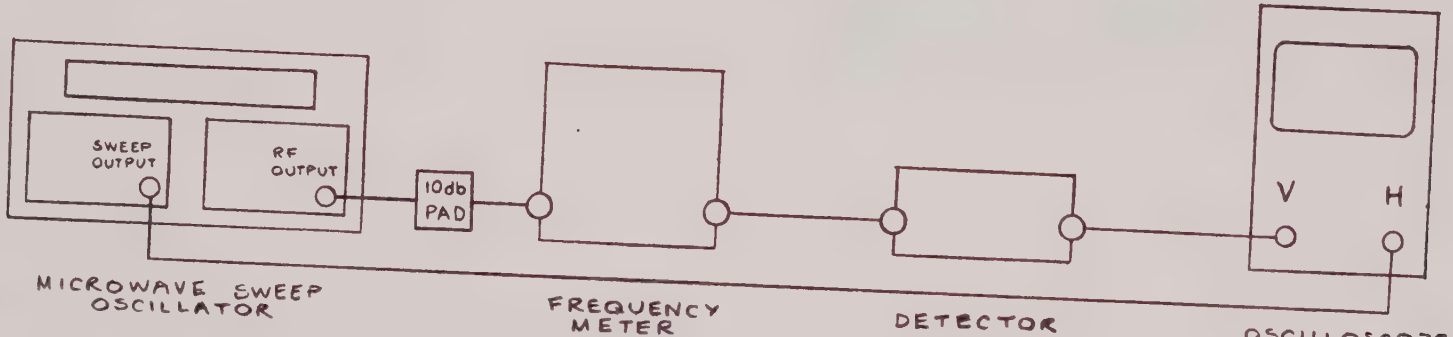
FIG. 1 CHANGES IN CONTROL SETTINGS



MICROWAVE SWEEP OSCILLATOR

POWER METER

FIG 2a. POWER MEASUREMENT



MICROWAVE SWEEP OSCILLATOR

FREQUENCY METER

DETECTOR

OSCILLOSCOPE

FIG 2b. FREQUENCY MEASUREMENTS.

CALIBRATION - OSCILLATOR UNIT

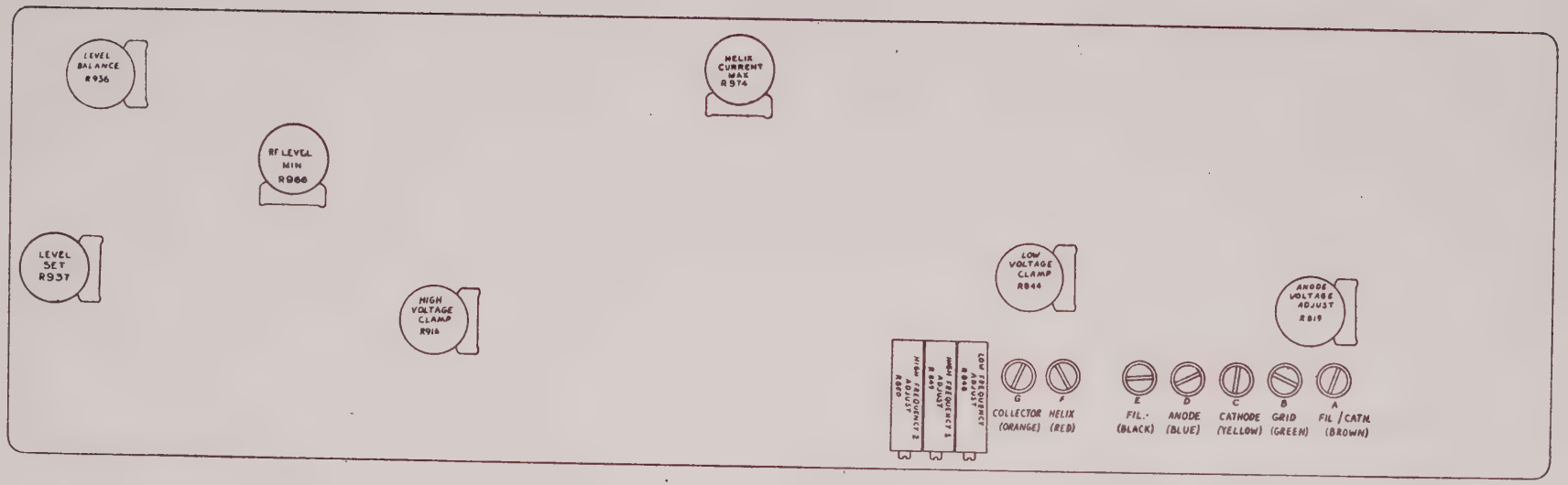


FIG 3. CALIBRATION ADJUSTMENTS AND TUBE CONNECTIONS — BWO UNITS

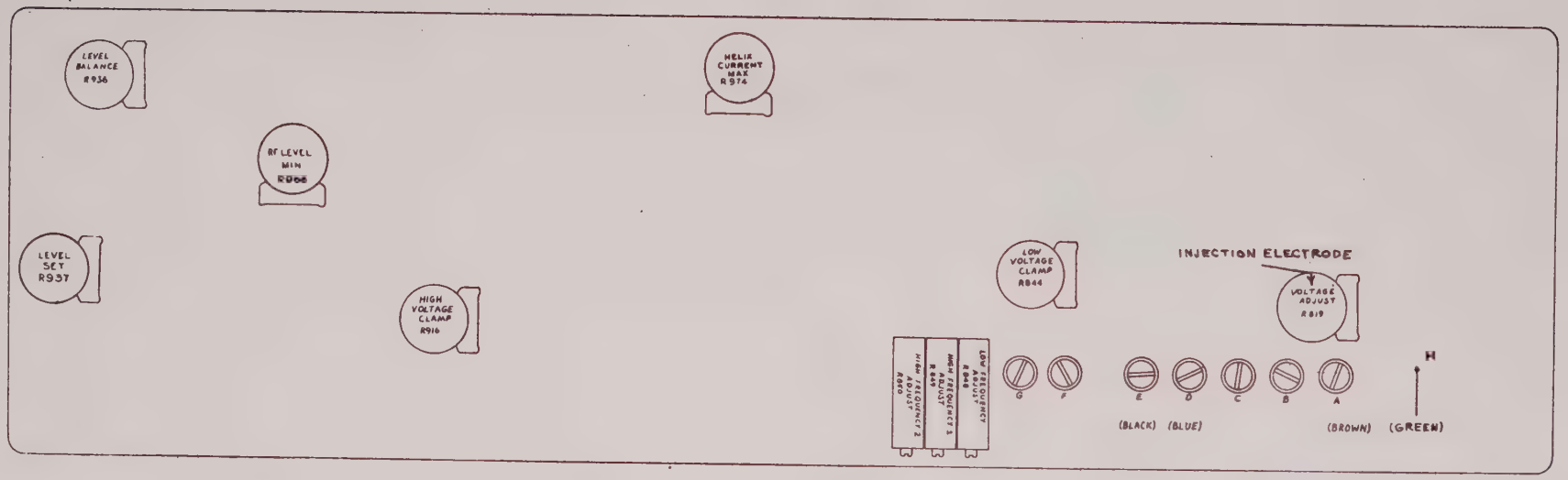


FIG 4. CALIBRATION — ADJUSTMENTS AND TUBE CONNECTIONS — VTM UNITS

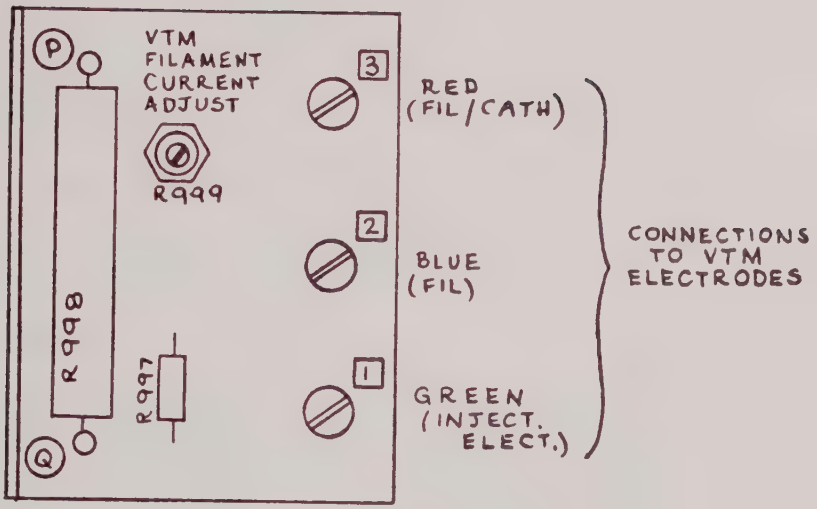


FIG 5. CALIBRATION – COMPONENT LOCATION FOR VTM UNITS

VIII. TUBE REPLACEMENT

CAUTION: Before proceeding with the tube replacement prepare a work space free of material that can be magnetized so as to avoid mishaps due to the high magnetic field associates with the microwave tube.

1. Remove the Oscillator Unit from the Basic Unit.

2. Disconnect the tube RF Output connection.

3. Disconnect the microwave tube power leads from the terminal board.

4. Remove the tube by removing its four mounting fasteners.

5. Place the new tube on the mounting plate and tighten in place with the four mounting fasteners.

6. Connect the tube RF connection.

7. If the entire equipment is to be calibrated at this time DO NOT CONNECT THE MICROWAVE TUBE POWER LEADS but first calibrate the Model 221 Basic Unit and connect the microwave tube only when required by the calibration procedure. Connect BWO'S upon completion of step 1. Connect VTM'S upon completion of step 3b. (For electrode connections refer to fig. 3, page 16for BWO and fig. 5, page 18 for VTM).

8. Enter on Page 1 of this manual the serial number and the magnitude of the parameters of the new tube, in place of the ones pertaining to the tube just replaced.

9. All adjustments in the Oscillator Unit should be recalibrated starting at step 1 of the Calibration Procedure section VII of this manual.

OSCILLATOR UNIT - GENERAL PARTS LIST

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
C801-C805	420-022	330pF 1kV 10% Cer	71590	DD331
C806	460-100	10pF 500V 10% Mica	84171	DM-15
C807	420-040	0.0047uF 1kV 10% Cer	56289	5GA-D47
C808	460-151	150pF 500V 10% Mica	84171	DM-15
C809,C810	430-032	0.22uF 50V 20% Myl	84411	601PE
C811***	420-035	0.002uF 1kV 20% Cer	56289	5GA-D20
C812	-	Factory selected		
C813	430-017	0.047uF 50V 20% Myl	84411	601PE
C814	400-043	10uF 25V 20% Elect	56289	TE-1204
C815	420-005	0.0025uF 6kV 20% Cer	71590	DA-111-0015
C816*,C817*	410-043	0.25uF 2.5kV 10% Film	18786	
C818	420-004	0.005uF 3kV 20% Cer	71590	DD30-502
C819	400-044	100uF 12V -10+100% Elect	56289	TE-1135
C820****	-	see parts list for specific unit		
C821	430-027	0.01uF 50V 20% Myl	84411	601PE
C822	430-024	0.02uF 50V 20% Myl	84411	601PE
C823	400-041	100uF 25V -10+100% Elect	56289	TE-1211
C824	430-011	0.1uF 50V 20% Myl	84411	601PE
C825	430-024	0.02uF 50V 20% Myl	84411	601PE
C826	460-221	220pF 500V 10% Mica	84171	DM-15
CD901	-	Detector, Crystal, see page 1.		
CR801	500-010	DIODE	01295	1N914
CR802	-	Not assigned		
CR803	500-008	DIODE	01295	U443
CR804	500-008	DIODE	01295	U443
CR805-CR807	500-008	DIODE	01295	U443
CR808-CR820	500-005	DIODE	14099	SCE2
CR821,CR822	-	Not assigned		
CR823	500-005	DIODE	14099	SCE2
CR824-CR826	-	Not assigned		
CR827	-	see parts list for specific unit		
CR828,CR829	-	Not assigned		
CR830,CR831	500-005	DIODE	14099	SCE2
CR832	-	Not assigned		
CR833	500-010	DIODE	01295	1N914
CR834	500-005	DIODE	14099	SCE2
CR835	-	Not assigned		
CR836	500-010	DIODE	01295	1N914
CR837-CR840	500-005	DIODE	14099	SCE2
CR841,CR842	-	Not assigned		
CR843	500-005	DIODE	14099	SCE2
CR844	-	Not assigned		
CR845-CR848	500-005	DIODE	14099	SCE2
CR849	-	Not assigned		
CR850	500-010	DIODE	01295	1N914
CR851	500-010	DIODE	01295	1N914

OSCILLATOR UNIT - GENERAL PARTS LIST

(CONT'D)

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
CR901	500-010	DIODE	01295	1N914
CR902	500-010	DIODE	01295	1N914
CR903	500-010	DIODE	01295	1N914
CR904	500-010	DIODE	01295	1N914
DC901	-	Coupler, directional, see page 1		
DM901	-	Modulator, diode, see page 1		
FL901	-	see parts list for specific unit		
J901,J902	234-003	Connector BNC	81862	1094/U
J903	234-003	Connector BNC (BWO units)	81862	1094/U
K901*	211-006	Relay, high voltage 4PDT	18786	
P901	234-004	Plug, male (mates with 26-190-32)	13511	26-159-32
PL901	214-006	Pilot light	18786	
Q801	502-005	TRANSISTOR	01295	2N697
Q802,Q803	502-013	TRANSISTOR	01295	2N3703
Q804	502-010	TRANSISTOR	01295	2N3707
Q805	502-015	TRANSISTOR	01295	2N2913
Q806	-	Not assigned		
Q807***	502-005	TRANSISTOR	01295	2N697
Q808***	502-014	TRANSISTOR	07263	2N3645
Q809	502-010	TRANSISTOR	01295	2N3707
Q810	502-005	TRANSISTOR	01295	2N697
Q811	502-013	TRANSISTOR	01295	2N3703
Q812	502-005	TRANSISTOR	01295	2N697
Q813	502-010	TRANSISTOR	01295	2N3707
Q814	502-010	TRANSISTOR	01295	2N3707
Q815-Q817	502-013	TRANSISTOR	01295	2N3703
Q818	502-010	TRANSISTOR	01295	2N3707
Q819	502-010	TRANSISTOR	01295	2N3707
Q820	502-005	TRANSISTOR	01295	2N697
Q821-Q823	502-010	TRANSISTOR	01295	2N3707
Q824	502-014	TRANSISTOR	07263	2N3645
Q825	502-013	TRANSISTOR	01295	2N3703
Q826,Q827	-	Not assigned		
Q828	502-015	TRANSISTOR	01295	2N2913

OSCILLATOR UNIT - GENERAL PARTS LIST

(CONT'D)

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
Q829	-	Not assigned		
Q830,Q831***	502-005	TRANSISTOR	01295	2N697
Q832***	502-014	TRANSISTOR	07263	2N3645
R801-R805	305-066	120K Ohm 7W 3% WW	91637	RLS-7
R806-R810	-	Not assigned		
R811-R813	305-059	665K Ohm 1W 1% Comp	91637	DC-1
R814	-	Not assigned		
R815	300-220	22 Ohm 1/4W 10% Comp	01121	RC07GF220K
R816	303-682	6.8K Ohm 2W 10% Comp	01121	RC42GF682K
R817	315-027	BWO units: 3.16K 1/8W 1% Met Film	91637	RN60C3161F
		VTM units: omit		
R818	-	see parts list for specific unit		
R819	304-020	100K Ohm 1/8W LIN VAR WW	71450	U201
R820	302-472	4.7K Ohm 1W 10% Comp	01121	RC32GF472K
R821	300-221	220 Ohm 1/4W 10% Comp	01121	RC07GF221K
R822	-	see parts list for specific unit		
R823	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R824-R842	-	see parts list for specific unit		
R843	305-034	400 Ohm 3W 1% WW	91637	RW79U4000F
R844	304-020	100K Ohm 1/8W LIN VAR WW	71450	U201
R845-R847	-	see parts list for specific unit		
R848	304-006	10K Ohm 1/2W LIN Multiturn	91637	2387
R849,R850	-	see parts list for specific unit		
R851	301-102	1K Ohm 1/2W 10% Comp	01121	RC20GF102F
R852	300-681	680 Ohm 1/4W 10% Comp	01121	RC07GF681K
R853	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R854	300-333	33K Ohm 1/4W 10% Comp	01121	RC07GF333K
R855	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R856	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF101K
R857	300-473	47K Ohm 1/4W 10% Comp	01121	RC07GF473K
R858	300-333	33K Ohm 1/4W 10% Comp	01121	RC07GF333K
R859,R860	-	see parts list for specific unit		
R861	300-473	47K Ohm 1/4W 10% Comp	01121	RC07GF473K
R862	300-333	33K Ohm 1/4W 10% Comp	01121	RC07GF333K
R863	300-332	3.3K Ohm 1/4W 10% Comp	01121	RC07GF332K
R864	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF101K
R865	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R866	300-473	47K Ohm 1/4W 10% Comp	01121	RC07GF473K
R867	-	see parts list for specific unit		
R868	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R869	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R870	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R871	-	see parts list for specific unit		
R872	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R873	301-222	2.2K Ohm 1/2W 10% Comp	01121	RC20GF222K
R874	301-221	220 Ohm 1/2W 10% Comp	01121	RC20GF221K
R875	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF101K

OSCILLATOR UNIT - GENERAL PARTS LIST

(CONT'D)

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
R876	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R877	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R878	300-153	15K Ohm 1/4W 10% Comp	01121	RC07GF153K
R879	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R880	-	see parts list for specific unit		
R881	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R882	300-153	15K Ohm 1/4W 10% Comp	01121	RC07GF153K
R883	300-331	330 Ohm 1/4W 10% Comp	01121	RC07GF331K
R884	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R885	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R886	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R887	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R888,R889	315-015	6.98K Ohm 1/8W 1% Met Film	91637	RN60C6981F
R890	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R891	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R892	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R893,R894	315-015	6.98K Ohm 1/8W 1% Met Film	91637	RN60C6981F
R895	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R896	-	see parts list for specific unit		
R897	300-473	47K Ohm 1/4W 10% Comp	01121	RC07GF473K
R898	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R899	303-102	1K Ohm 2W 10% Comp	01121	RC42GF102K
R900,R901	-	see parts list for specific unit		
R902	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R903	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF101K
R904	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R905****	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R906	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF101K
R907	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R908	300-332	3.3K Ohm 1/4W 10% Comp	01121	RCo7GF332K
R909	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R910,R911	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R912	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R913	300-683	68K Ohm 1/4W 10% Comp	01121	RC07GF683K
R914	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R915	300-683	68K Ohm 1/4W 10% Comp	01121	RC07GF683K
R916	304-023	2K Ohm 1/8W LIN VAR	71450	U201
R917	303-102	1K Ohm .2W 10% Comp	01121	RC42GF023K
R918	300-221	220 Ohm 1/4W 10% Comp	01121	RC07GF102K
R919	300-101	100 Ohm 1/4W 10% Comp	01121	RC07GF221K
R920	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R921	303-682	6.8K Ohm 2W 10% Comp	01121	RC42GF682K
R922,R923	-	Not assigned		
R924	300-153	15K Ohm 1/4W 10% Comp	01121	RC07GF153K
R925	300-473	47K Ohm 1/4W 10% Comp	01121	RC07GF473K
R926	300-333	33K Ohm 1/4W 10% Comp	01121	RC07GF333K
R927	315-031	20.5K Ohm 1/8W 1% Met Film	91637	RN60C2052F
R928,R929	315-060	100 Ohm 1/8W 1% Met Film	91637	RN60C1000F
R930	300-222	2.2K Ohm 1/4W 10% Comp	01121	RC07GF222K
R931	315-031	20.5K Ohm 1/8W 1% Met Film	91637	RN60C2052F

OSCILLATOR UNIT - GENERAL PARTS LIST

(CONT'D)

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
R932	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R933,R934	-	Not assigned		
R935	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R936	304-018	1K Ohm 1/8W LIN VAR	71450	U201
R937	-	see parts list for specific unit		
R938	315-009	348 Ohm 1/8W 1% Met Film	91637	RN60C3480F
R939	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R940	300-103	10K Ohm 1/4W 10% Comp	01121	RC07GF103K
R941	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R942	300-221	220 Ohm 1/4W 10% Comp	01121	RC07GF221K
R943	300-106	10M 1/4W 10% Comp	01121	RC07GF106K
R944-R946	305-006	120K Ohm 10W 1% WW	91637	RS-10
R947,R948*	305-052	10M 2W 1% Comp	91637	DC-2
R949*	303-103	10K Ohm 2W 10% Comp	01121	RC42GF103K
R950*	303-220	22 Ohm 2W 10% Comp	01121	RC42GF220K
R951	304-016	1.5K Ohm 1/2W REV LOG VAR	01121	JAIN0485 S102BA
R952	304-009	10K Ohm 1/2W LOG VAR	01121	JAIN048 S103UA
R953	304-010	10K Ohm 1/2W LIN VAR	18786	
R954-R962	-	see parts list for specific unit		
R963	300-104	100K Ohm 1/4W 10% Comp	01121	RC07GF104K
R964	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R965	-	Not assigned		
R966	304-023	2K Ohm 1/8W LIN VAR	71450	U201
R967	300-471	470 Ohm 1/4W 10% Comp	01121	RC07GF471K
R968	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R969	315-022	24.9K Ohm 1/8W 1% Met Film	91637	RN60C2492F
R970	315-033	46.4K Ohm 1/8W 1% Met Film	91637	RN60C4642F
R971	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R972	300-104	100K Ohm 1/4W 10% Comp	01121	RC07GF104K
R973	300-223	22K Ohm 1/4W 10% Comp	01121	RC07GF223K
R974	304-023	2K Ohm 1/8W LIN VAR	71450	U201
R975	300-470	47 Ohm 1/4W 10% Comp	01121	RC07GF470K
R976***	300-102	1K Ohm 1/4W 10% Comp	01121	RC07GF102K
R977	300-472	4.7K Ohm 1/4W 10% Comp	01121	RC07GF472K
R978-R996	-	Not assigned		
R997**	315-013	2.80K Ohm 1/8W 1% Met Film	91637	RN60C2801F
R998**	306-011 (2)	1.0 Ohm 10W 3% WW Parallel	91637	RS10
R999**	306-010	1.0 Ohm 12.5W LIN VAR	44655	E#0101
S801	210-005	Switch, rotary SP10T	18786	
S802	210-013	Switch, rotary 12P4T	18786	
V901	-	Microwave tube see page 1		

OSCILLATOR UNIT - GENERAL PARTS LIST

(CONT'D)

Reference Designation	Micro-Power Part Number	Description	Code Ident	Mfg No
Z801	-	Not assigned		
Z802**-Z804	501-014	DIODE	03877	IN989
Z805-Z815	-	Not assigned		
Z816	501-007	DIODE	03877	IN753A
Z817-Z819	501-008	DIODE	03877	IN759
Z820	501-007	DIODE	03877	IN753A
Z821-Z823	-	Not assigned		
Z824	501-007	DIODE	03877	IN753A
Z825	501-008	DIODE	03877	IN759
Z826	501-007	DIODE	03877	IN753A
Z827	-	see parts list for specific unit		
Z828	-	Not assigned		
Z829	501-007	DIODE	03877	IN753A
Z830,Z831	-	Not assigned		
Z832	501-008	DIODE	03877	IN759
Z833,Z834	-	Not assigned		
Z835	501-008	DIODE	03877	IN759
Z836	501-007	DIODE	03877	IN753A
Z837-Z841	-	Not assigned		
Z842	501-007	DIODE	03877	IN753A
Z843	-	Not assigned		
Z844-Z846	501-007	DIODE	03877	IN753A
Z847,Z848	501-008	DIODE	03877	IN759

* Not included in VTM and BWO units with "B" suffix.
** Included in VTM units only.
*** The above value for BWO units only. For VTM units see specific parts list.
**** For D or DL units, see specific parts list.

ACCOPRESS®

25970	YELLOW
25971	BLACK
25972	LIGHT BLUE
25973	DARK BLUE
25974	LIGHT GRAY
25975	LIGHT GREEN
25976	DARK GREEN
25977	TANGERINE
25978	RED
25979	EXECUTIVE RED

GENUINE PRESSBOARD

ACCO INTERNATIONAL INC.
CHICAGO, ILLINOIS 60619

MP MASTER
MA35936
85492